

I claim:

1. A baseball bat comprising:
 - a handle portion for gripping;
 - a cylindrical tubular hollow void barrel portion for striking; and
 - a tapered mid-section portion connecting said handle portion and said barrel portion;

said handle, barrel and mid-section portions constructed solely of a polymer composite material,

said polymer composite material comprising a thermoset resin and continuous length reinforcement fibers,

said continuous length reinforcement fibers comprising multiple intertwined tubular braid forms,

said intertwined tubular braid forms being arranged in multiple layers.
2. The baseball bat of claim 1, wherein said bat is constructed using a precision molding process.
3. The baseball bat of claim 1, wherein said thermoset resin is selected from a group of thermoset resins consisting of epoxy, vinyl ester, polyester and urethane.
4. The baseball bat of claim 1, wherein said multiple layers of said multiple intertwined tubular braid forms comprise at least four layers.
5. The baseball bat of claim 1, wherein said handle portion has a handle length and said barrel portion has a barrel length, and wherein said continuous length reinforcement fibers in said handle portion have a handle fiber length and said continuous length reinforcement fibers in said barrel portion have a barrel fiber length; and wherein said handle fiber length is greater than said handle portion length and said barrel fiber length is greater than said barrel portion length.
6. The baseball bat of claim 1, wherein the baseball bat has a bat length, and each of said multiple intertwined tubular braid forms has a braid form length, and wherein said braid form length of at least one of said multiple intertwined tubular braid forms is

substantially equal to said bat length, and wherein said braid form length of at least another one of said multiple intertwined tubular braid forms is less than said bat length.

7. The baseball bat of claim 1, wherein said continuous length reinforcement fibers are arranged at a resultant fiber angle relative to a central longitudinal axis of the bat, and wherein an average of the absolute values of all of said resultant fiber angles in said handle portion is less than an average of the absolute values of all of said resultant fiber angles in said barrel portion, thereby providing said handle portion with desirable mechanical properties that differ from said desirable mechanical properties of said barrel portion.
8. The baseball bat of claim 7, wherein said average of the absolute values of all of said resultant fiber angles in said handle portion is between 5° and 30° less than said average of the absolute values of all of said resultant fiber angles in said barrel portion.
9. The baseball bat of claim 7, wherein said average of the absolute values of all of said resultant fiber angles in said handle portion is less than 20° and said average of the absolute values of all of said resultant fiber angles in said barrel portion is greater than 25°.
10. The baseball bat of claim 7, wherein said desirable mechanical properties in said handle portion include a first bending mode frequency of 100 to 600 hertz and said desirable mechanical properties in said barrel portion include a first hoop frequency of 800 to 2000 hertz.
11. The baseball bat of claim 7, wherein said desirable mechanical properties in said handle portion include an axial stiffness of between 50,000 lb/in² and 250,000 lb/in², and said desirable mechanical properties in said barrel portion include a radial stiffness of between 70,000 lb/in² and 350,000 lb/in².
12. The baseball bat of claim 1, wherein said handle portion includes at least one layer of said continuous length reinforcement fibers arranged in a stitched tubular form, said continuous length reinforcement fibers in said stitched tubular form having a resultant fiber angle of 0° relative to a central longitudinal axis of the bat.

13. The baseball bat of claim 1, wherein said barrel portion has a barrel portion wall thickness less than .2 inches.
14. The baseball bat of claim 1, wherein said continuous length reinforcement fibers are comprised of between 85% and 100% fiberglass fibers.
15. The baseball bat of claim 2, wherein said precision molding process comprises the steps of:
 - placing said multiple layers of said multiple intertwined tubular braid forms of said continuous length reinforcement fibers over a solid precision mandrel;
 - placing said mandrel into a closeable external precision mold;
 - closing and sealing said mold;
 - heating said mold;
 - injecting said mold with said thermoset resin, thereby combining said thermoset resin with said continuous length reinforcement fibers in a resin-fiber matrix;
 - allowing said resin to cure, thereby forming said polymer composite material;
 - extracting said mandrel and said polymer composite material from said mold;and
 - extracting said mandrel from said polymer composite material.
16. The baseball bat of claim 15, wherein,
 - said barrel portion has a finished outside diameter having a barrel portion outside diameter tolerance of $\pm .001$ inches,
 - said barrel portion has a finished wall thickness having a barrel portion wall thickness tolerance of $\pm .001$ inches,
 - said barrel portion has a finished roundness having a barrel portion roundness tolerance of $\pm .003$ inches, and
 - the bat has a finished bat weight having a bat weight tolerance of $\pm 1/16$ th ounces.
17. A precision molding process for making a baseball bat, comprising the steps of:
 - placing multiple layers of continuous length reinforcement fibers over a solid precision mandrel;
 - placing said mandrel into a closeable external precision mold;

closing and sealing said mold;
heating said mold;
injecting said mold with a thermoset resin, thereby combining said thermoset resin with said continuous length reinforcement fibers in a resin-fiber matrix;
allowing said resin to cure, thereby forming a polymer composite material;
extracting said mandrel and said polymer composite material from said mold;
and
extracting said mandrel from said polymer composite material.

18. The process of claim 17, wherein said continuous length reinforcement fibers comprise multiple intertwined tubular braid forms.
19. The process of claim 18, wherein said multiple layers of said multiple intertwined tubular braid forms comprise at least four layers.
20. The process of claim 18, wherein the baseball bat has a handle portion and a barrel portion, and said handle portion has a handle length and said barrel portion has a barrel length, and wherein said continuous length reinforcement fibers in said handle portion have a handle fiber length and said continuous length reinforcement fibers in said barrel portion have a barrel fiber length, and wherein said handle fiber length is greater than said handle portion length and said barrel fiber length is greater than said barrel portion length.
21. The process of claim 18, wherein the baseball bat has a bat length, and each of said multiple intertwined tubular braid forms has a braid form length, and wherein said braid form length of at least one of said multiple intertwined tubular braid forms is substantially equal to said bat length, and wherein said braid form length of at least another one of said multiple intertwined tubular braid forms is less than said bat length.
22. The process of claim 17, wherein the baseball bat has a handle portion and a barrel portion and said continuous length reinforcement fibers are arranged at a resultant fiber angle relative to a central longitudinal axis of the bat, and wherein an average of the absolute values of all of said resultant fiber angles in said handle portion is less than an average of the absolute values of all of said resultant fiber angles in said barrel portion,

thereby providing said handle portion with desirable mechanical properties that differ from said desirable mechanical properties of said barrel portion.

23. The process of claim 22, wherein said average of the absolute values of all of said resultant fiber angles in said handle portion is between 5° and 30° less than said average of the absolute values of all of said resultant fiber angles in said barrel portion.
24. The process of claim 22, wherein said average of the absolute values of all of said resultant fiber angles in said handle portion is less than 20° and said average of the absolute values of all of said resultant fiber angles in said barrel portion is greater than 25°.
25. The process of claim 22, wherein said desirable mechanical properties in said handle portion include a first bending mode frequency of 100 to 600 hertz and said desirable mechanical properties in said barrel portion include a first hoop frequency of 800 to 2000 hertz.
26. The process of claim 22, wherein said desirable mechanical properties in said handle portion include an axial stiffness of between 50,000 lb/in² and 250,000 lb/in², and said desirable mechanical properties in said barrel portion include a radial stiffness of between 70,000 and 350,000 lb/in².
27. The process of claim 17, wherein the baseball bat has a handle portion and a barrel portion and said handle portion includes at least one layer of said continuous length reinforcement fibers arranged in a stitched tubular form, said continuous length reinforcement fibers in said stitched tubular form having a resultant fiber angle of 0° relative to a central longitudinal axis of the bat.
28. The process of claim 17, wherein a barrel portion of the baseball bat has a barrel portion wall thickness less than .2 inches.
29. The process of claim 17, wherein said continuous length reinforcement fibers are comprised of between 85% and 100% fiberglass fibers.

30. The process of claim 17, wherein,
- a barrel portion of the baseball bat has a finished outside diameter having a barrel portion outside diameter tolerance of $\pm .001$ inches,
 - said barrel portion has a finished wall thickness having a barrel portion wall thickness tolerance of $\pm .001$ inches,
 - said barrel portion has a finished roundness having a barrel portion roundness tolerance of $\pm .003$ inches, and
 - the bat has a finished bat weight having a bat weight tolerance of $\pm 1/16$ th ounces.